

faced manner in which triangles and figures are moved about and turned about and placed upon one another.

The second chapter treats of the subject as handled in the Elementary Treatises, taking chiefly for the basis of remarks the fourth edition of the Geometry, by Messrs. Rouché and De Comberousse.

Chapters III. and IV. are occupied with Trigonometry, and Chapter V., closing the work, treats of Mechanics. The volume is too technical to allow of an extended criticism here, but we can commend it to geometrical students. No statement is made as to how it comes to pass that such a volume was issued under the auspices of the Society named above.

### LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

#### New Methods of Moving Ordnance

IN anticipation of an interesting paper and discussion at the intended meeting of the British Association at Sheffield, a complete set of working models has been prepared at the Floating Dock, North Shields, to explain several new applications of a new method of moving ordnance with ease and rapidity of motion in small space, with economy of time and labour.

The most recent of these improvements is an adaptation of the principles of the tramway and tram car, in making use of the perfectly level surface, and the retaining groove, either on the ship's deck or on the platform of a battery. But instead of flanges on the wheels, that have a tendency to clog and compress dirt into the grooves, and "gag" on the edges, a hanging longitudinal guide-plate projects below the wheels on the inside of the rails; this allows greater freedom of action to the wheel and gives greater security, and in order to attain greater power of resistance to any shock or concussion, the guide plates are strengthened by a cross connecting the plate between them. The gun carriage slide has turn-table pivots on four wheels, that can be placed anywhere; as for the real or imaginary centres of motion at the ends, or centrally or to correspond with the present A B C D pivots of the Royal Artillery, which when in line or parallel or at any angle to each other act as stationary or moving pivots or fulcra for a lever movement of the slide, to turn or move in any direction on perfectly straight lines, as the shortest route between any two points, and also as best adapted for the application of a direct action of any of the usual mechanical motive powers.

North Shields, August 1

GEORGE FAWCUS

#### "Law of Frequency"

THE term "law of frequency" seems to be used in two distinct senses by mathematical writers. In the ordinary theory the ambiguity leads to little confusion except to beginners; but this is owing to a fortunate, though altogether special, property of the hypothesis on which the theory is based. When we come to investigate other possible theories, it becomes highly important to keep the distinction in mind. Suppose, for clearness' sake, that we have before us a large number of measurements of a single unknown quantity. On examining them we find that a considerable number agree pretty closely with each other, several are more obviously discrepant, while one or two are widely so. Conversely we are led to think of the frequency with which a given measurement occurs as a function of the magnitude of the measurement itself. Denoting this magnitude by  $x$ , we may represent the relative frequency of its occurrence by  $\phi(x)$ . This function is called the "law of frequency of the measurement  $x$ ," and it is in this sense that statisticians often use the phrase.

But if we consider all the possible measurements that may be made of the quantity, we see that their number is practically infinite. The relative frequency of any proposed measurement

becomes therefore infinitesimal, and we must seek for some other expression. This we find by inverting our ideas, as it were, and asking, not "What is the frequency of a given measurement  $x$ ?" but "What is the probability that a given measurement shall lie between the two very near values  $x$  and  $x + \delta x$ ?" Suppose that our particular theory gives us this latter probability as  $\psi(x) \delta x$ . Then mathematicians generally are wont to call  $\psi(x)$  "the law of frequency of the measurement  $x$ ."

A little consideration will show that on one hypothesis only are  $\phi(x)$  and  $\psi(x)$  necessarily of the same form. This hypothesis is that the arithmetic mean of our fallible measurements is the best value of the quantity measured which we can obtain from them. From this the ordinary law,  $\phi(x) \propto e^{-h^2 x^2}$ , easily follows.

But if the nature of our measurements (or other discrepant magnitudes) be such as to suggest that some other mean is likely to be nearer the truth than the arithmetic mean, we shall find that the forms of  $\phi(x)$  and  $\psi(x)$  are not the same. It seems, therefore, desirable that a real distinction in the things signified should be marked by a corresponding distinction in the terms applied to them. If it be not too bold a suggestion, might we not "desynonymise" the terms "law of frequency" and "law of facility," keeping the former for the function I have called  $\phi(x)$ , and the latter for the commoner function I have represented by  $\psi(x)$ ?

DONALD MCALISTER

St. John's College, Cambridge, July 28

#### Carica Papaya

THANKS to Mr. Whitmee for his timely correction of my perhaps too dogmatic assertion as to the seeds of the Papau being rejected by birds, at p. 241. Had I not written off-hand I should have qualified the sentence "the birds however will not touch them," i.e. the fruit, by adding "as far as I have observed."

We had flocks of small birds inhabiting the casuerinas and banyans which shaded our sea-side quarters at Rivière Noire, Mauritius; they were mostly small birds such as "bengalis," (*Estrela amandava*), "senegalis," (*Estrela astrilda*), "cal-fats," (*Munia oryzirova*) "tuit-tuits," (*Oxyotus ferrugineus*), cardinals, crithagras, serins, &c., as numerous as finches and sparrows in our English gardens: but never did I see any of these birds, which were as bold and tame as possible, peck at the papau either on the plants or on the ground; had they been in the habit of doing so I must have observed them. The "martins" or minas of the interior did not trouble us with their visits and noisy chatterings, so I cannot say whether they affect the papau seeds much. It is possible that the "pigeons marrons" and various "tourterelles" may have fed on the papau fruit but I never found any of the seeds in their crops.

The flying foxes, "collets rouges," (*Pteropus Edwardsii*), used to come down in numbers to eat the mangoes of our neighbour, Mons. Genève; when we used to shoot them on moonlight nights and find them remarkably good eating, but I never knew or heard of their eating the papau, which perhaps they do. The conditions of the Mascarene and Navigator's islands are probably different, as the *Carica* certainly does not spring up as a weed wherever forests are cleared in Mauritius, or Bourbon. The *Carica papaya* figures as a cultivated and not an intrusive plant in Dr. Charles Pickering's table of observed localities of plants introduced throughout Polynesia; distinguishing for each plant, whether it appears to be native, or spontaneously disseminated, and whether when introduced apparently by the hand of man it has become naturalised or intrusive. Certainly Dr. Pickering's work is out of date (1848), and I have not yet seen his new work *Chronological History of Plants* (Trübner, 1879).

Whilst on this subject I may subjoin a paragraph I came across in a number of the *Gardener's Chronicle* about the papau, with which I conclude.

"Utilisation of the Papaw.—The peculiar properties of the Papaw (*Carica papaya*) in causing the separation of animal tissues, and thus rendering newly-killed meat tender, is a fact that has been frequently written about and commented upon by travellers. Our contemporary, *The Chemist and Druggist*, suggests, as a 'possible specialty,' the production of some convenient preparation from the tree which should contain the same properties as the leaves, or whether the leaves themselves might be dried and still retain their activity. 'There is no doubt,' they say, 'that a preparation which really embodied

these virtues would be very popular, and that it would soon become one of the necessities of life, without which no careful housekeeper would allow herself to be left.' It is further pointed out that, as the tree is abundant, and the expense of collecting the leaves would probably be very small, it would be quite worth while to procure a quantity either of the leaves or the juice from the West Indies, and endeavour to obtain a suitable preparation therefrom. If the leaves are brought they might be packed fresh in barrels, which should be filled with salt water—not sea water—and in this way imported; or the juice might be expressed from them and saturated with salt, or preserved with benzoic or salicylic acid, and sent over in any convenient vessels. Experience would prove if they would retain these properties when so treated.' These hints may be worth the consideration of some of our readers in countries where the Papaw is abundant."

Anglesey, Gosport, August 4

S. P. OLIVER

### The Pacific Salmon

THE reviewer of the U.S. Fisheries' Commission Report, 1875-6, in *NATURE*, vol. xix. p. 429, pointedly refers with doubt to a statement that "so far as yet observed the adult fish of the Pacific salmon (*Salmo gairdneri*) all die after spawning" quoted from a memorandum which I wrote on the subject for the information of the New Zealand Government.

In support of this I would refer to the evidence given in a previous volume of the same reports, 1872-3, p. 191 and elsewhere. This phenomenon, remarkable though it be, is so entirely in accordance with my own observations made during two seasons spent on the upper waters of the Columbia river in 1859-60, and with the opinions I heard expressed by Indians and trappers, that I thought I was justified in mentioning it as a peculiarity of importance.

It may interest your readers to learn that a million of salmon ova of this species have been imported to New Zealand, and that over 700,000 have been hatched and that some 40 rivers have been stocked with the young fish.

Through the great liberality of the American Government at the instance of Prof. Spencer Baird, this invaluable addition to the future food resources of the Colony, has been effected at the cost of only a few hundred pounds to the Colonial Government.

JAMES HECTOR

Colonial Museum of New Zealand, Wellington, May 10

### A New Spectroscope

IN *NATURE*, vol. xx. p. 256, a description of M. Cornu's spectroscope for observation of the ultra-violet rays is given.

The lens of the collimator, and that of the observing spectroscope are said to be composed of a double convex lens of quartz achromatized by means of a plano-concave of Iceland spar, both cut parallel to the optical axis. His prisms are said to be of quartz.

Will you allow me to state that I have used an exactly similar arrangement for the last three years, with the exception that the two prisms are of Iceland spar, which has higher dispersive power. The object glasses were ground and polished for me by Mr. Ahrens of the Liverpool Road. I named the plan about two years ago to my friend Prof. McLeod, and have found it very successful in working.

WILLIAM H. STONE

14, Dean's Yard, Westminster, S.W., August 4

### "The Rights of an Animal"

I BELIEVE that when a writer feels himself to have been entirely misrepresented by his reviewer, editorial fairness allows him, at least in such journals as admit correspondence, to set himself right with the reader. The reviewer of my "Rights of an Animal" in *NATURE*, vol. xx. p. 287, says that, when I claim for animals "the same abstract rights of life and personal liberty with man," I use an ambiguous word which casts its shadow over the entire work and makes it unsatisfactory. I should have thought "same" clearly meant "identical." My reviewer says that this cannot be my meaning, because I allow animals to be killed for food and to be worked. He forgets that I have shown how the law of self-preservation overrules the rights both of animals and of men, that it warrants our checking breeding in animals, and that the animals which I allow to be killed or worked were only allowed to come into life for those purposes.

He says that I consider it "immoral to eat shrimps and lob-

sters." I have indeed asked how we are to defend the killing of "fresh- or salt-water fish or crustaceans," but I have suggested an answer, and have merely added "is this plea sound?" That I leave a question doubtful does not justify a reviewer in saying that I decide it in a particular way.

I will not follow him into an argument between a very sophisticated "philosopher" and a very stupid lobster, wherein the former gains an inglorious victory; but, when he in his proper person reproduces, anent another question, one of the philosopher's arguments, and charges me with "the same inconsistency of principle"—because "if man has a moral right to slay a harmful animal in order to better his own condition, he must surely have a similar right to slay a harmless animal, if by so doing he can secure a similar end"—I must protest that "principle" and "self-interest" are not synonymous, and that a writer who can pen such a sentence is no more capable of reviewing an ethical essay than I of reviewing a book on diamagnetism.

Lastly, he has (even in transcribing my title-page) omitted all mention of my reprints from Lawrence's interesting and very scarce work, and has conveyed to the reader an impression that my book consists of only about 60 pp., an impression very damaging to the chance of the reader buying or even borrowing it.

EDWARD B. NICHOLSON

London Institution

### Intellect in Brutes

MR. HENSLOW's question (*NATURE*, vol. xix. p. 433) reminds me of the celebrated carp and bucket of water problem, put by King Charles the Second. He had better have put it thus—"Did ever a person know a dog (or other animal) ring a bell to bring a servant, &c." How can any one tell if an animal goes through any "process of reasoning," save by the results? What will Mr. Henslow say to the following, for which I can vouch, as can others now living? For my part, having watched animals since my childhood, I am fully convinced of their "powers of reasoning" to a certain extent.

Many years ago we lived in Cambridge, in Emmanuel House, at the back of Emmanuel College. The premises were partly cut off from the road by a high wall; the body of the house stood back some little distance. A high trellis, dividing off the garden, ran from the entrance door to the wall, in which was another door, or gate. A portion of the house, a gable, faced the trellis. These particulars are necessary, as you will see.

We were, after some time of residence, extremely troubled by "run-away-rings," generally most prevalent at night, and in rainy, bad, or cold weather, which was a great annoyance to the servant girls, who had to cross the space between the house and the wall, to open the outer door in the latter, and were thus exposed to wet and cold.

The annoyance became so great that at length a cousin and myself, armed with wicked ash saplings, watched behind the trees on "Jesus' Piece," bent on administering a sound thrashing to the enemy, whoever he was, that disturbed our "domestic peace." *Mirabile dictu!* the rings continued, but no one pulled the bell handle! Being a very old house, they were now of course set down to ghosts! but not believing in those gentry, I was puzzled. Chance, however, revealed the originator of the scare.

Being ill I was confined to the wing facing the trellis, and one miserable, blowing, wet day, gazing disconsolately out of the window, espied my favourite cat—a singularly intelligent animal, much petted—coming along the path, wet, draggle-tailed, and miserable.

Pussy marched up to the house-door, sniffed at it, pushed it, mewed, but finding it firmly shut, clambered up to the top of the trellis, some eight or ten feet from the ground, reached a paw over the edge, scratched till she found the bell-wire which ran along the upper rail from the wall to the house, caught hold of it, gave it a hearty pull, then jumped down, and waited demurely at the door. Out came the maid, in rushed Puss. The former, after gazing vaguely up and down the street, returned, muttering "blessings," no doubt, on the ghost, to be confronted by me in the hall.

"Well, Lydia, I have at last found out who rings the bell." "Lard, Master! ye harvent surely!"—she was broad "Zamer-zetsheer." "I have; come and see. Look out of the breakfast room window, but don't show yourself." Meanwhile, I went into the drawing-room, where Mrs. Puss was busy drying herself before the fire. Catching her up, I popped her outside of the door, and ran round to my post of observation.